



Armed Forces College of Medicine AFCM



Endocrine System

Adrenal gland

&

Pineal gland

Ass. Prof. Dr. Walaa Baher

INTENDED LEARNING OBJECTIVES (ILO)



By the end of this lecture the student will be able to:

1. Explain the structure of the adrenal gland & Pineal gland
2. Relate the defective structure of adrenal gland & pineal gland cells to different clinical conditions

Lecture Plan



1. Part 1 (5 min) Introduction
2. Part 2 (35 min) Main lecture-pars nervosa structure & adrenal gland
3. Part 3 (5 min) Summary
4. Lecture Quiz (5 min)



Adrenal Glands (Supra renal gland)

Adrenal glands



- Paired organs, lying near the superior poles of the kidney.
- Structure is formed of:

Stroma

- Mainly reticular fibers forming dense capsule that sends trabeculae into the parenchyma.

Parenchyma

Cortex

- **Mesodermal in origin.**
- **90% of the gland weight.**
- **Secrete steroid hormones**

Medulla

- **Origin from neural crest.**
- **Catecholamines secreting cells.**
- **Under control of preganglionic sympathetic neurons.**

Suprarenal glands



All cells in the adrenal cortex are **steroid secreting cells.**
Characterized by:

L/M: - Acidophilic cytoplasm rich in lipid droplets.
- Central nuclei.

E/M: (4 characters)

- 1) +++SER with interconnected tubules, why?
- 2) Spherical mitochondria with tubular cristae, Why?
- 3) **No secretory granules**, but lipid soluble molecules diffuse freely through cell membrane.
- 4) Lipid droplets

Suprarenal glands



+++SER with interconnected tubules, why?

Because they contain enzymes for:

- Cholesterol synthesis.**
- Conversion of pregnenolone → Active steroid hormone.**

Spherical mitochondria with tubular cristae, Why?

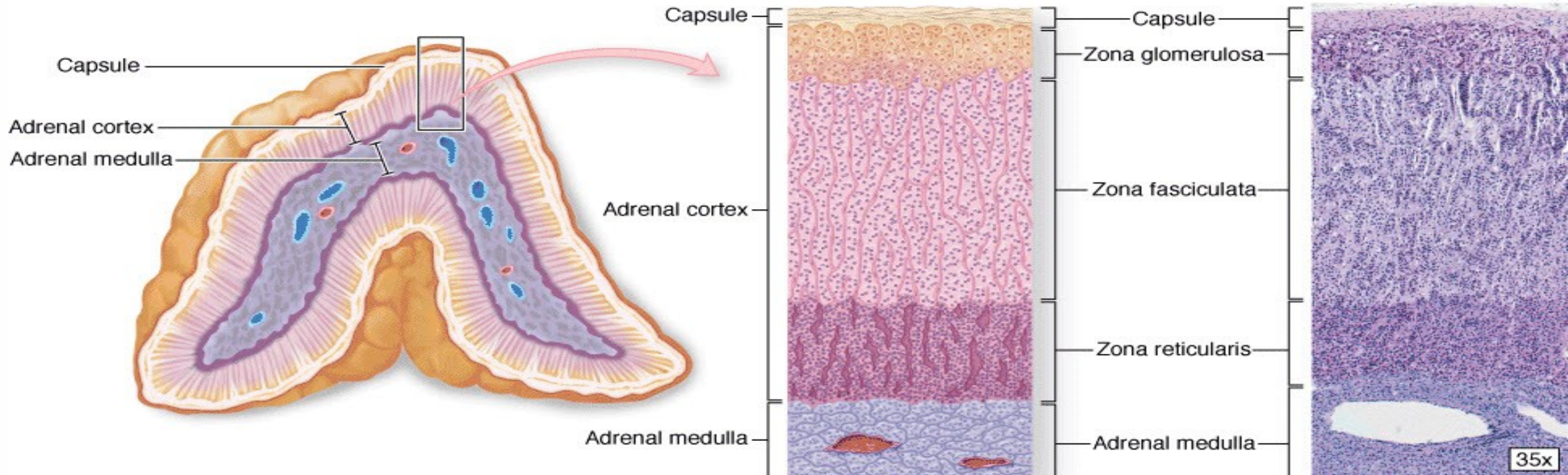
Because it contains enzymes that convert cholesterol to pregnenolone, besides enzymes of ATP synthesis.

Adrenal cortex



The Adrenal cortex is formed of 3 zones:

- 1- Zona Glomerulosa (15%).
- 2- Zona Fasciculate (65-80%).
- 3- Zona Reticularis (10%).

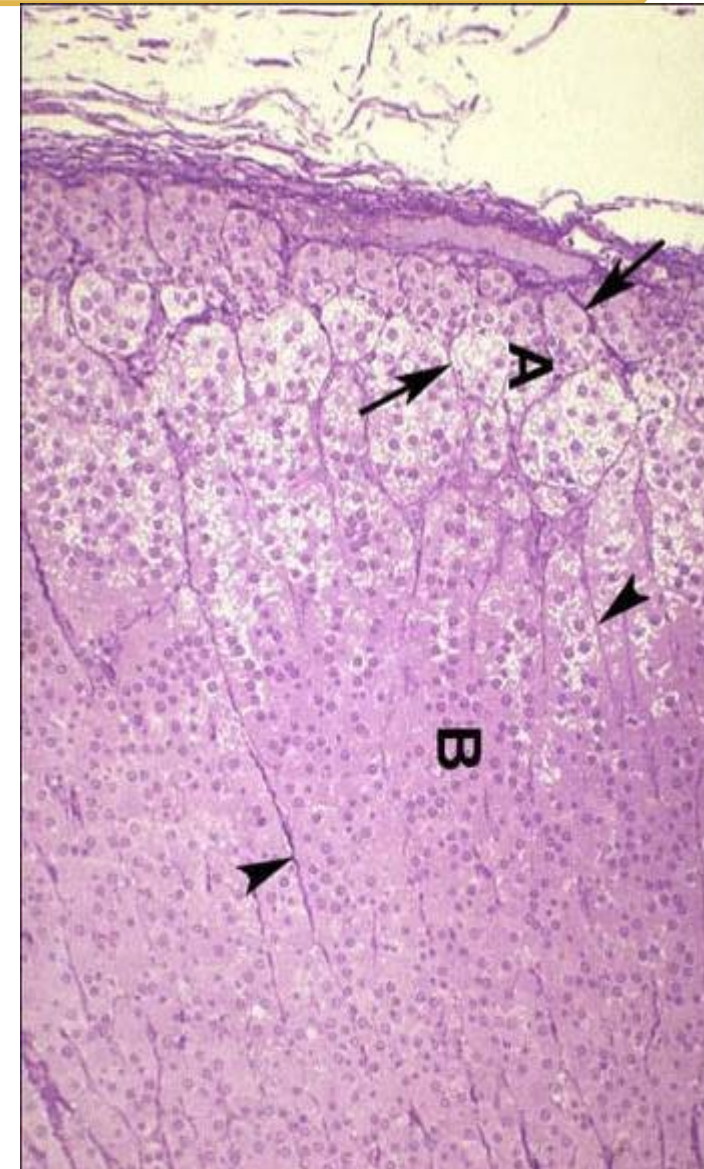


1- Zona Glomerulosa



- Just beneath the capsule.
- Cells are closely packed and arranged in arched cords of columnar or pyramidal cells.
- Numerous Capillaries.
- Contain few lipid droplets, Mitochondrial cristae are shelf-like, Golgi, rER & free ribosomes.
- Secrete **mineralocorticoids** mainly

Aldosterone



Zona glomerulosa

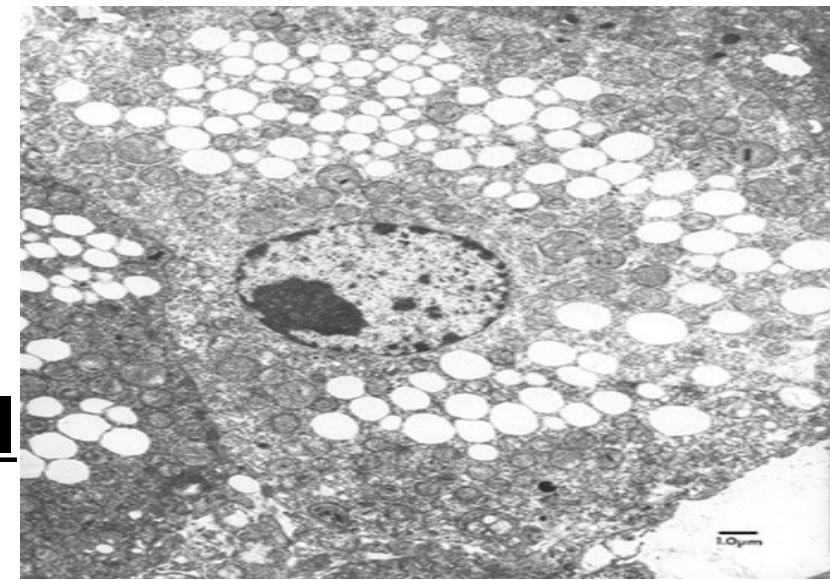
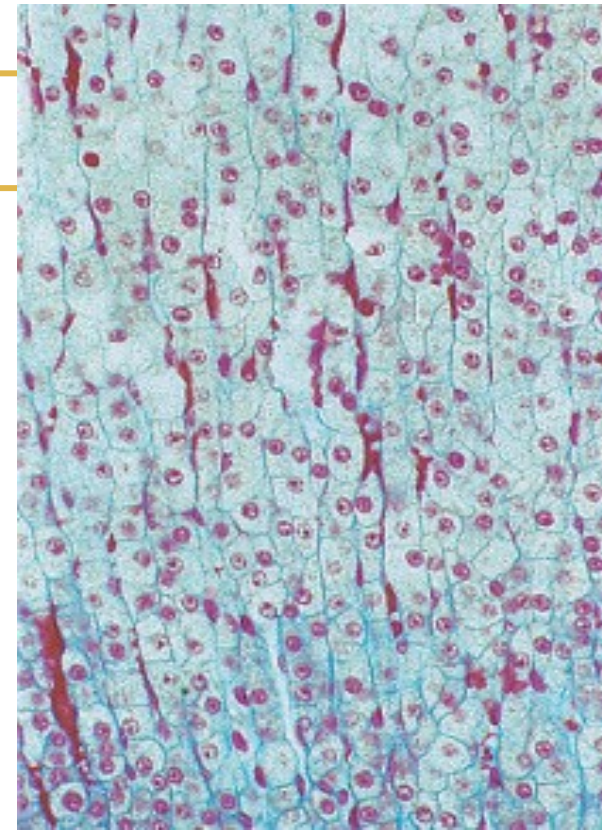


Aldosterone acts on:

- Distal convoluted tubules.
 - Gastric mucosa.
 - Salivary glands
 - Sweat glands
- } Increase reabsorption sodium

2- Zona Fasciculata

- Formed of cords of large polyhedral cells, one or two cells thick, separated by fenestrated blood sinusoids.
- Cells may be binucleated and contain numerous fat droplets □ vacuolated by L/M.
- Cytoplasm show Golgi & rER.
- Secrete Glucocorticoids namely **Cortisol**



Zona Fasciculata

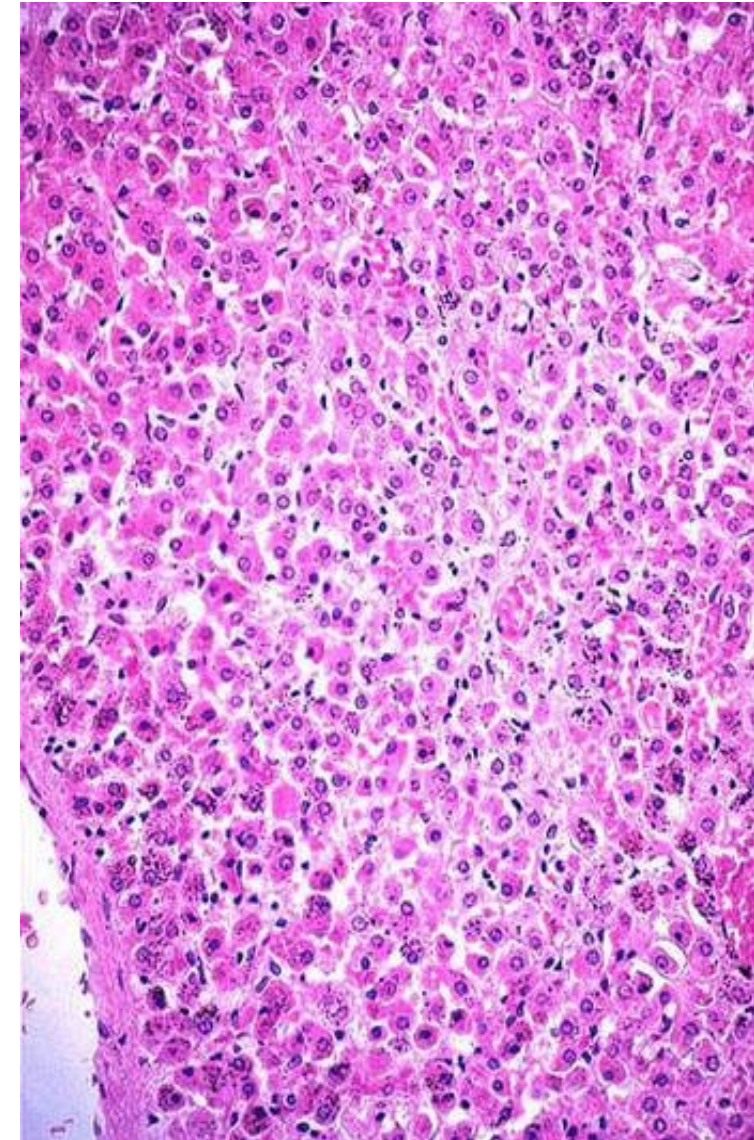


- **Cortisol acts on many** different cells and tissues to increase the metabolic availability of glucose and fatty acids, (immediate sources of energy).
- Suppress immune function – promote fat mobilization and muscle proteolysis.
- Control of cortisol secretion is under **feedback mechanism of ACTH.**
 - **(hypothalamo- pituitary- adrenal- axis)**

3- Zona Reticularis



- Innermost zone.
- Formed of small cells arranged in irregular cords with wide capillaries inbetween.
- Appear darker than other zones due to fewer lipid droplets & few rER.
- Have light cells and dark cells with large **lipofuscin pig.** (accumulated byproducts of lipid metabolism) and deeply stained nuclei.



Zona Reticularis



Secrete weak androgens (gonadocorticoids) namely Dehydroepiandrosteron (DHEA) which is converted into testosterone in both ♂ & ♀, and few cortisol.

In ♂, have negligible importance , why?

Because testosterone produced by the testis is a much more powerful androgen.

In ♀, stimulate growth of axillary and pubic hair during puberty and adolescence

Clinical correlations



Disorders of the adrenal cortex can be

classified as
Hyperfunctional

Excessive production of :
- Glucocorticoid → **Cushing syndrome**
- Aldosterone → **Conn syndrome.**
- Adrenal androgens → has little effect in men, but
-In boys → precocious puberty .
-In girls → hirsutism
(abnormal hair growth) and **virilization** (in girls).

Hypofunctional

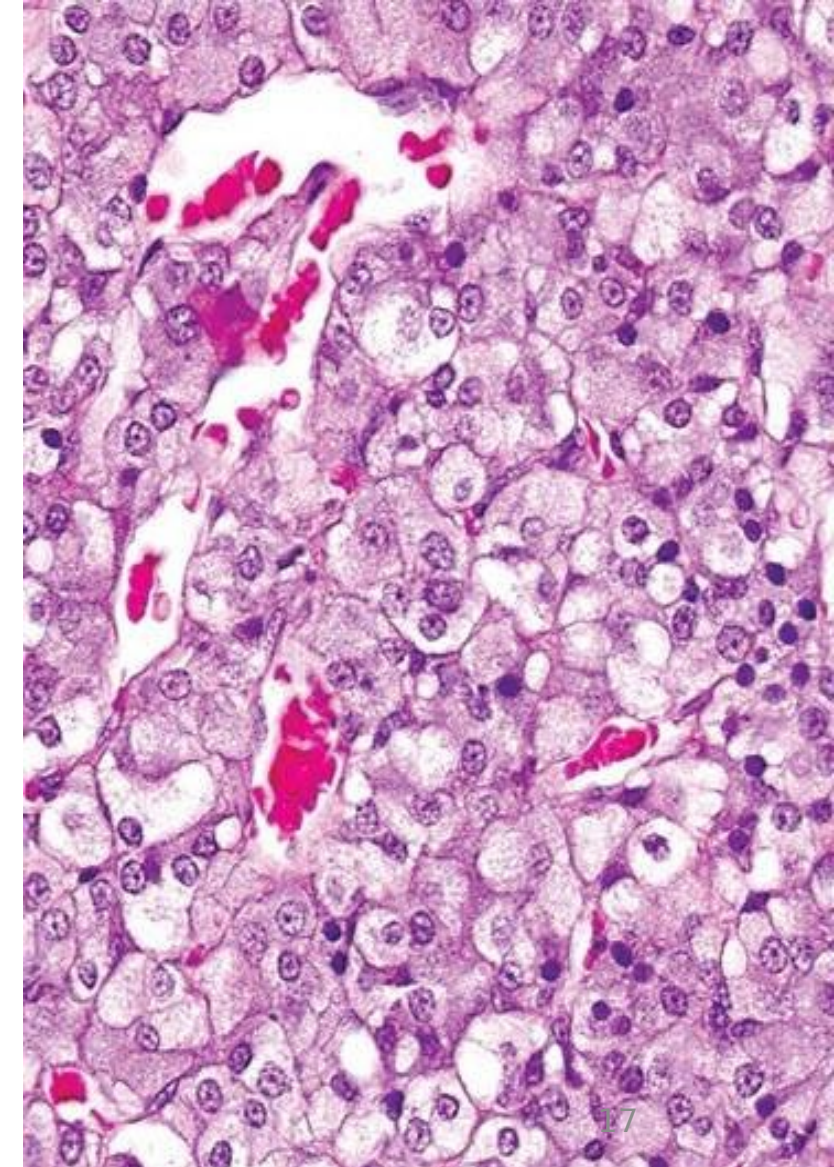
- Destruction of the adrenal cortex → adrenocortical insufficiency (**Addison disease**).
- The signs and symptoms suggest failure of secretion of both glucocorticoids and mineralocorticoids by the adrenal cortex.

Adrenal Medulla



- Occupy central portion of adrenal gland.
- Contains **Chromaffin cells, Ganglion cells**, reticular CT, numerous fenestrated capillaries, and nerves.
- The cells are arranged in clusters and branching cords.

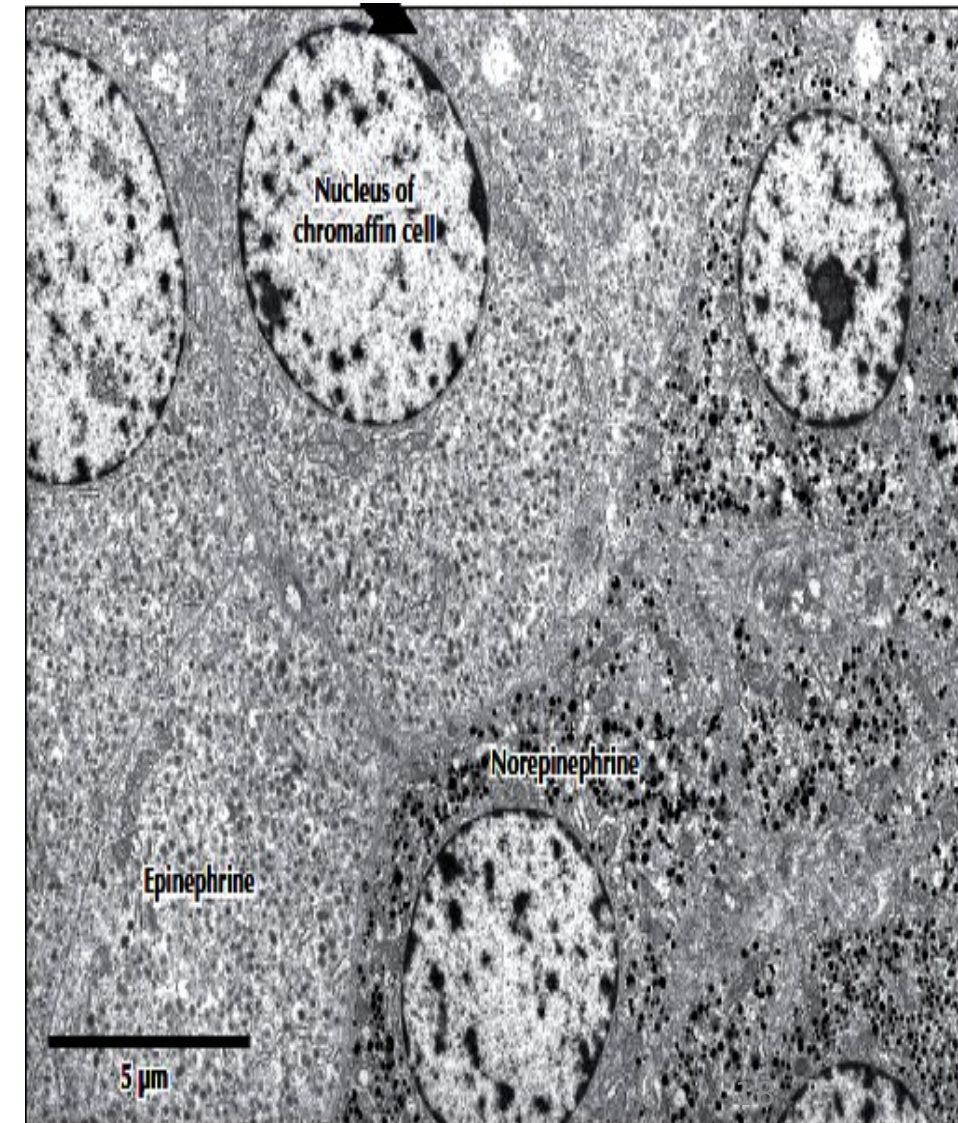
Chromaffin cells' granules stain brown with solutions containing dichromate ions, thus termed **chromaffin**.



Adrenal Medulla



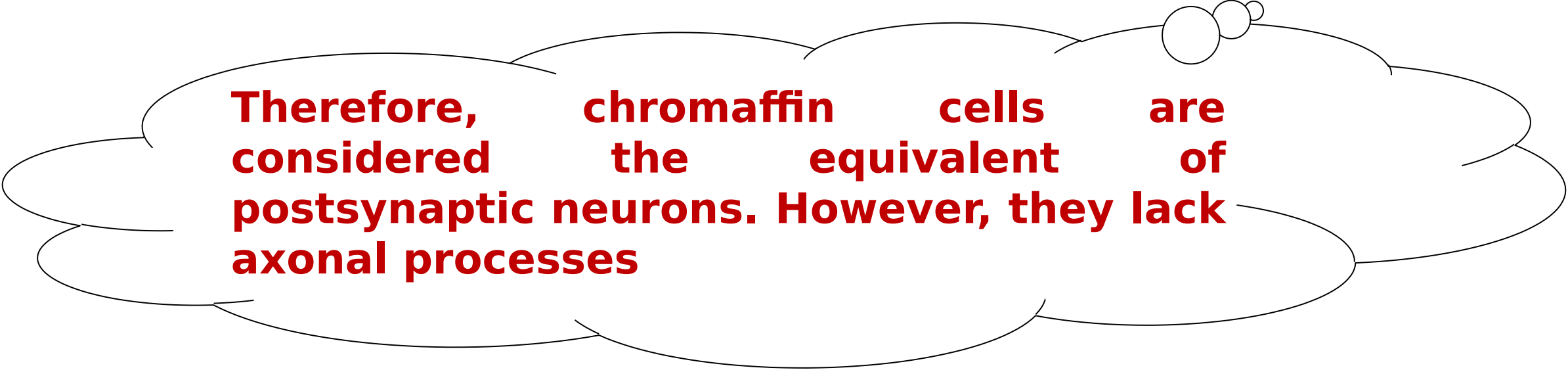
- **Chromaffin cells:**
 - Pale staining epitheloid cells.
 - E/M: well developed golgi, rER, **secretory vesicles** 100-300nm.
 - Secretory vesicles are either:
 - **Large dense core**, containing **norepinephrin**, or
 - **Smaller , more homogenous** and less electron dense, containing **epinephrin**.



Adrenal Medulla



Numerous myelinated, presynaptic sympathetic nerve fibers pass directly to the chromaffin cells. When nerve impulses carried by them reach chromaffin cells, they release their secretory products.



Therefore, chromaffin cells are considered the equivalent of postsynaptic neurons. However, they lack axonal processes



- **Ganglion cells :**
- Represent the cell bodies of preganglionic sympathetic neurons.
- Their axons extend peripherally to cells of the **adrenal cortex** to modulate its secretory activity, and extend **outside the gland** to the splanchnic nerves innervating abdominal organs.

Adrenal Medulla



- Secretory vesicles contain also, **Chromogranin, ATP** and **Ca**, which bind to catecholamines and are released with the hormones during exocytosis.
- Glucocorticoids secreted in the cortex induce the conversion of norepinephrine to epinephrine in chromaffin cells (blood supply).
- The catecholamines, with the glucocorticoids, prepare the body for the "fight-or-flight" response through glycogenolysis and mobilization of free fatty acids from adipose tissue.

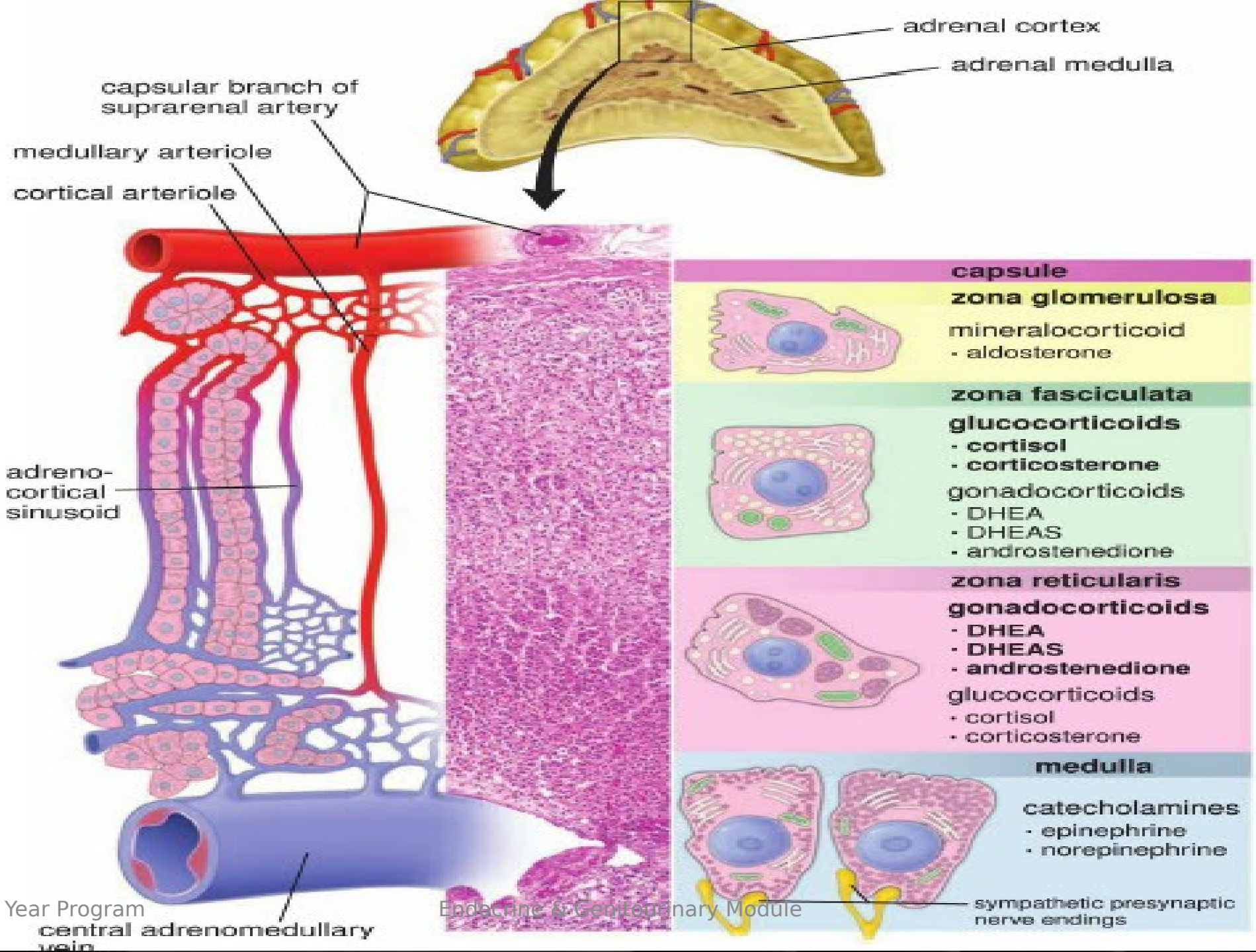


Clinical applications

Pheochromocytoma: is a tumor of adrenal medulla cells that causes hyperglycemia and transient elevations of blood pressure.



Adrenal glands





Pineal gland

Pineal Gland



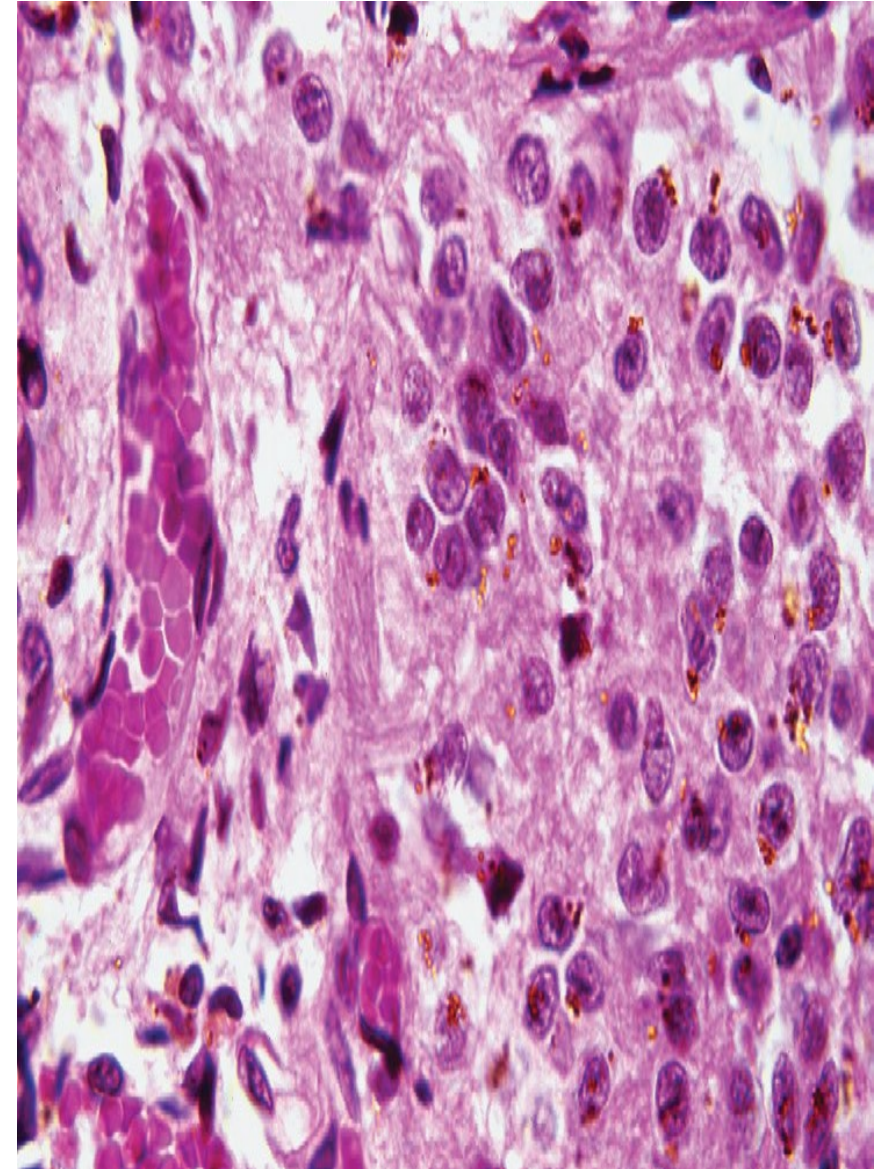
- - Known as ***Epiphysis cerebri***.
- - Derived from neuroectoderm.
- - Covered by pia matter that extend CT septa which divides the glands into lobules.
- - **Parenchyma is formed of 2 types of cells:**
 - 1) Pinealocytes.
 - 2) Modified astrocytes (glial or interstitial cells).

Pinealocyte



L/M:

- Arranged in clusters or cords
- Pale basophilic cytoplasm contain lipid droplets.
- Irregular euchromatic nuclei.

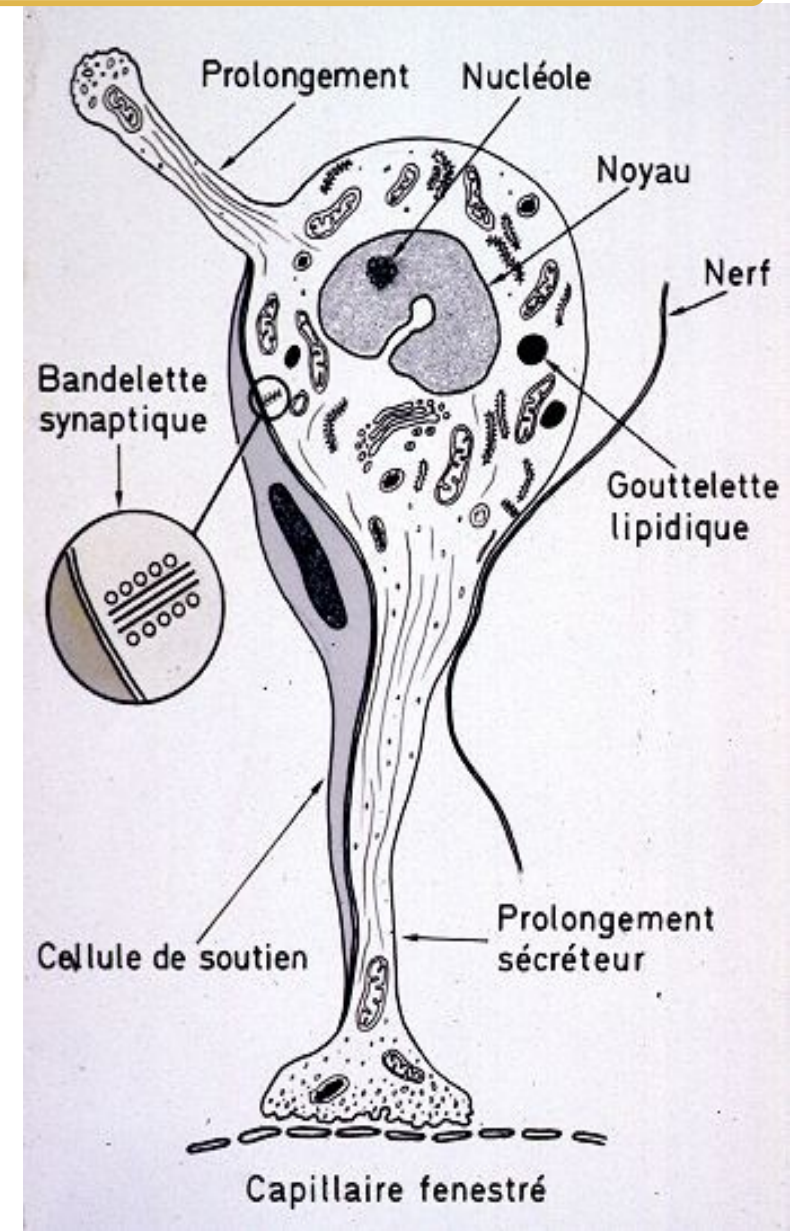


Pinealocytes



- **E/M:**

- - Many mitochondria, Golgi, rER.
- - Dense core secretory vesicles.
- Randomly distributed Synaptic ribbons.
- -Cytoplasmic processes containing parallel microtubules and end in dilatations around blood capillaries.



Modified astrocytes (interstitial or glial cells)

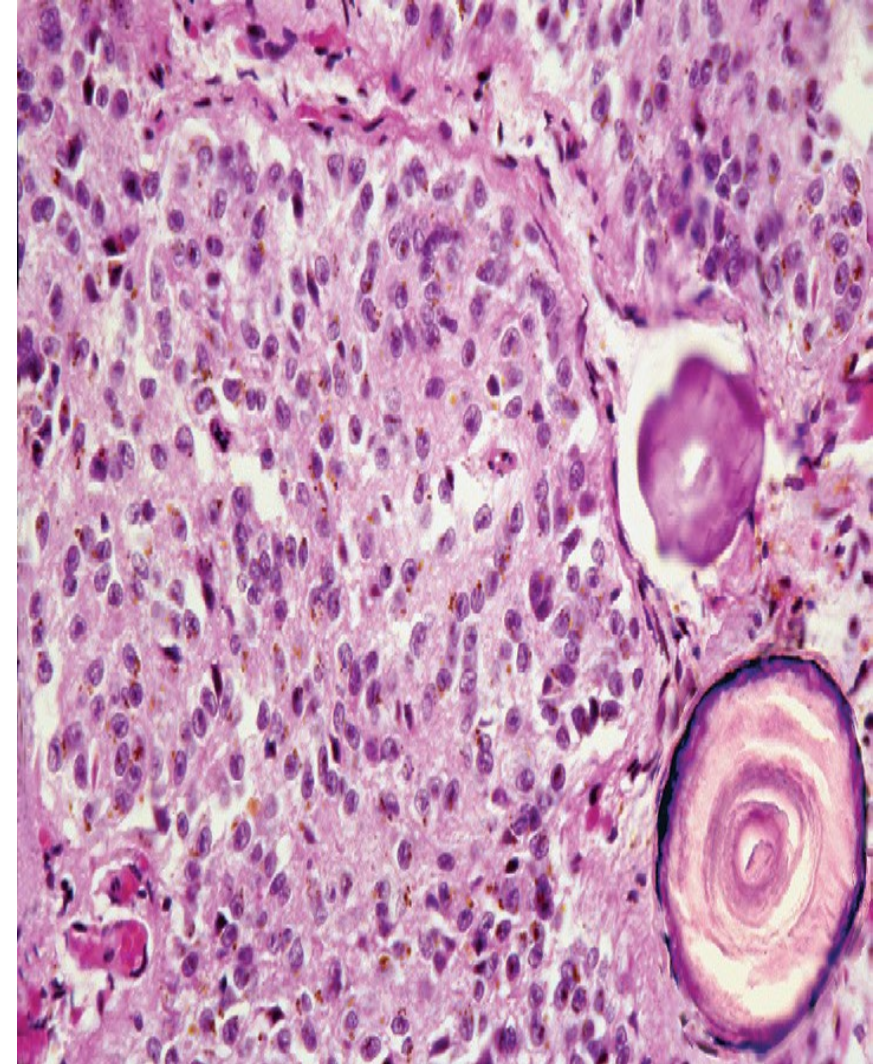


- Represent 5% of cells in pineal body.
- +ve for glial fibrillary protein.
- Have deeply stained elongated nucleus.
- Present in the perivascular areas and in between pinealocytes.

Corpora arenacea



- Basophilic concretions seen in pineal gland
- Also called **brain sand**.
- Represent mineralized protein deposits.
- Increase in number and size with age.



Pineal gland



- Pinealocyte secrete **Melatonin** during darkness
- Melatonin □ inhibit steroidogenic activity of gonads.
- i.e: Melatonin deficiency → precocious puberty.

Melatonin inhibits GnRH secretion from hypothalamus → decrease in the release of FSH and LH from the anterior lobe of the pituitary gland.

Melatonin secretion is inhibited by **Light** and **β adrenergic antagonists**.

Lecture Quiz



Which one of the following hormones is secreted by cells rich in lipofuscin pigment?

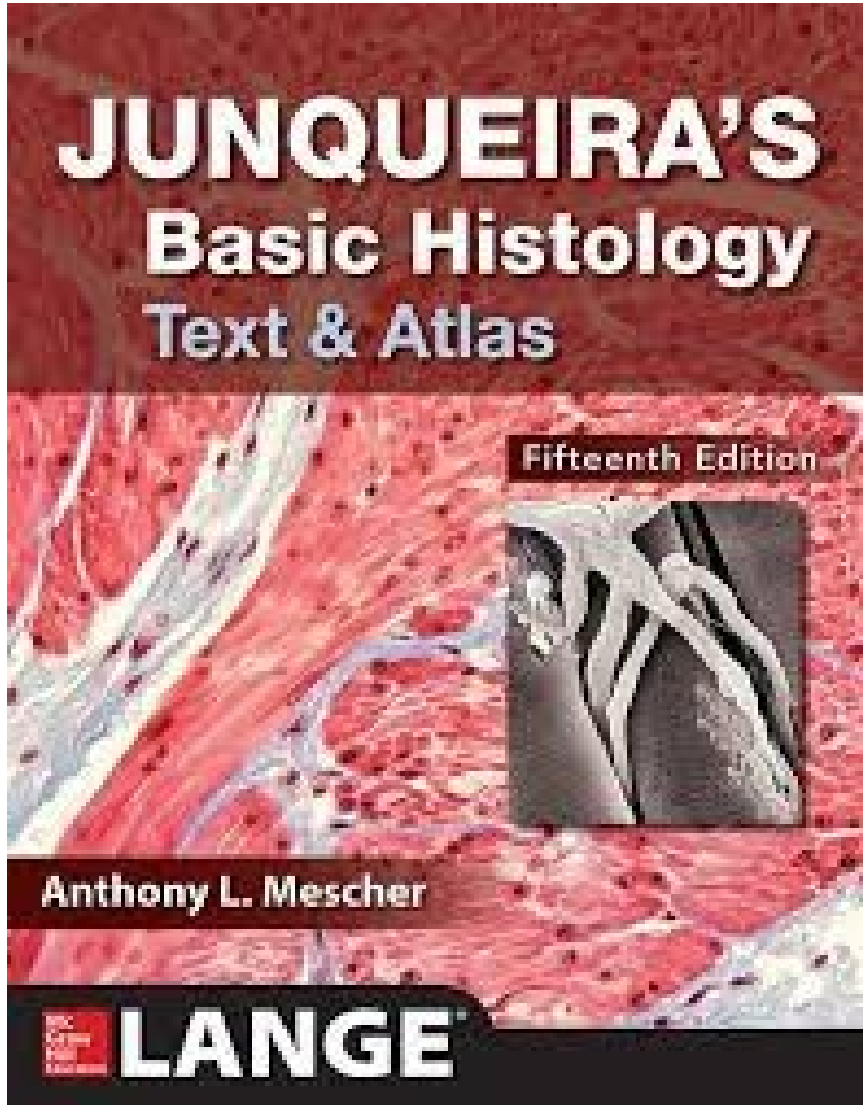
- a. Aldosterone
- b. Cortisol
- c. Prolactin
- d. DAHEA
- e. T3



Secretion in what neuroendocrine cell is controlled directly by neural activity and involves a hormone that generally slows metabolic activity at night?

- a. Pituicyte
- b. Melanocyte
- c. Herring body of the neurohypophysis
- d. Chromaffin cell
- e. Pinealocyte

SUGGESTED TEXTBOOKS



Chapter 20: Endocrine glands. Pp. 423-427